



US Army Research Laboratory



Weapons and Materials Research

Armament Research For Ground Forces



Bruce Burns

Al Horst

Ed Schmidt

Dennis Viechnicki

Spectrum of Military Operations





Focusing Technology Innovation

... Smaller, Smarter & Lighter



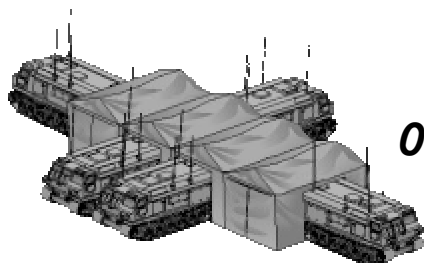
Today



***~100 lb.
load***



***70+
tons***



0 mph

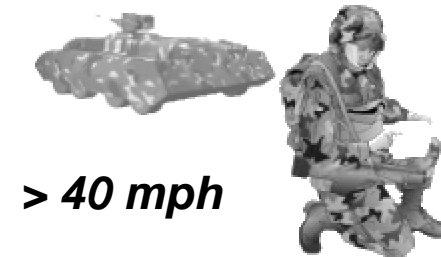
***S&T
-- Accelerating
the pace of Army
Transformation***

Objective Force

***<1/3 body wt
load***



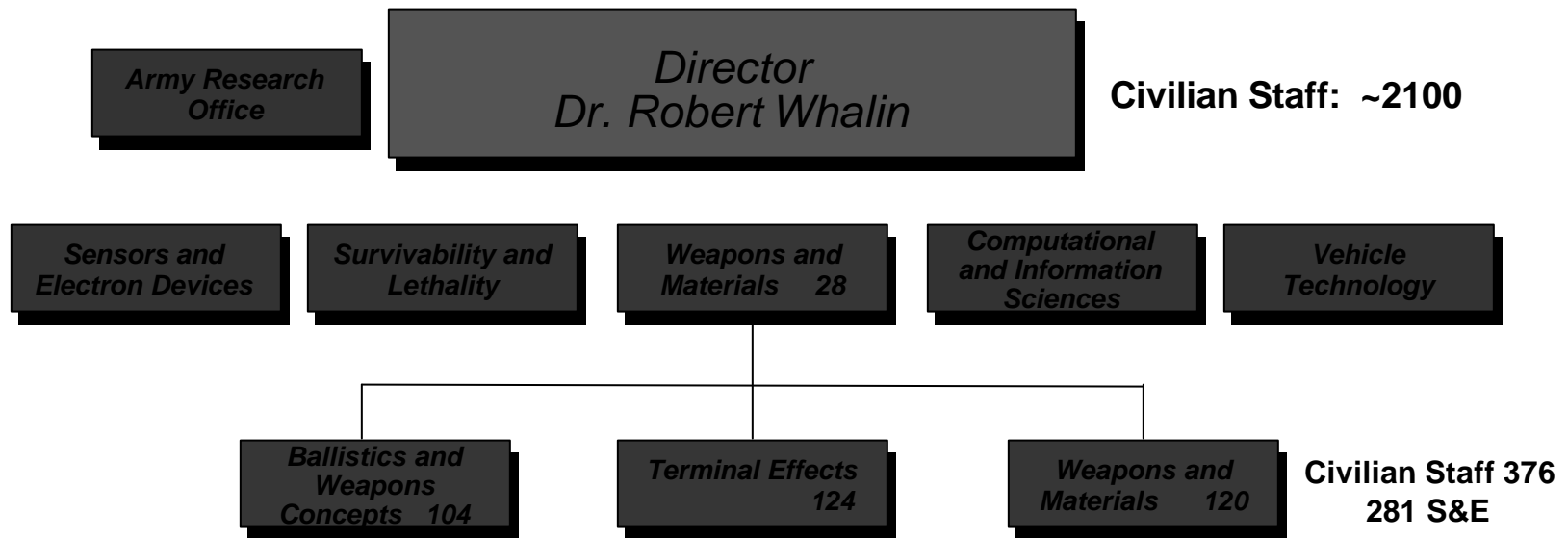
***< 20
tons***



> 40 mph



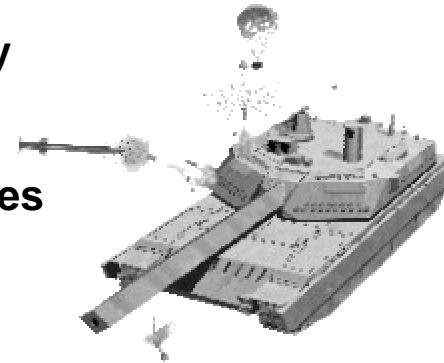
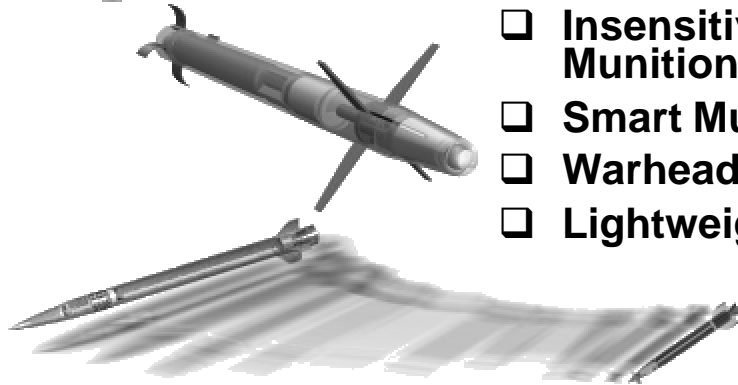
Army Research Laboratory





WMRD Work Areas

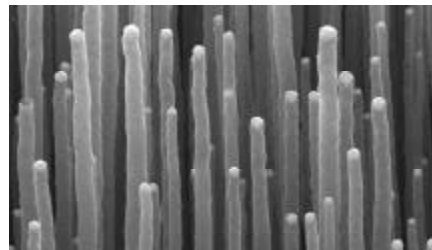
- ☐ Insensitive High-Energy Munitions
- ☐ Smart Munitions
- ☐ Warheads and Projectiles
- ☐ Lightweight Ordnance



- ☐ KE Active Protection
- ☐ Vehicle Protection
- ☐ Personnel Protection

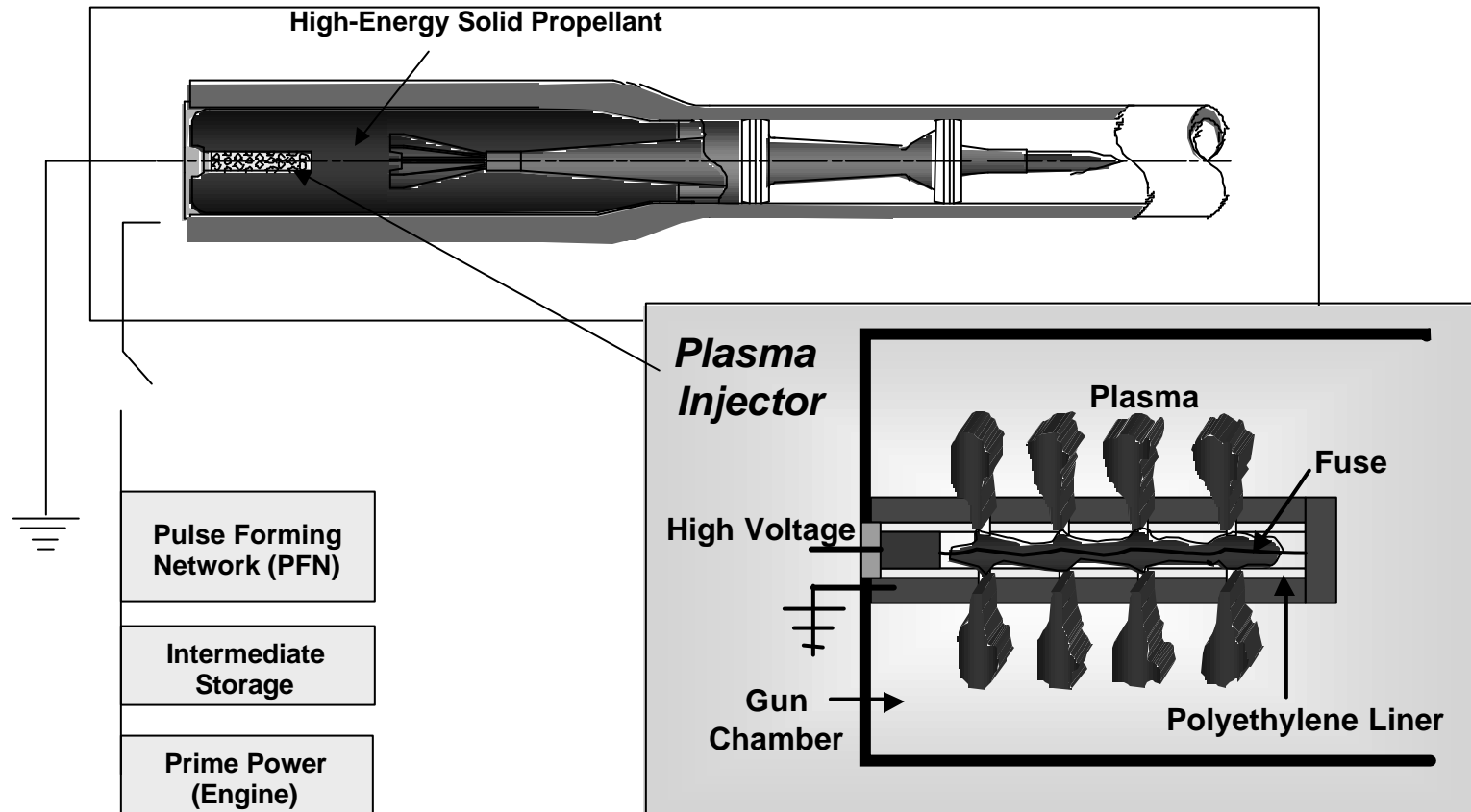


- ☐ Robotics
- ☐ Composites Applications
- ☐ Enabling Materials





ElectroThermal Chemical (ETC) Propulsion



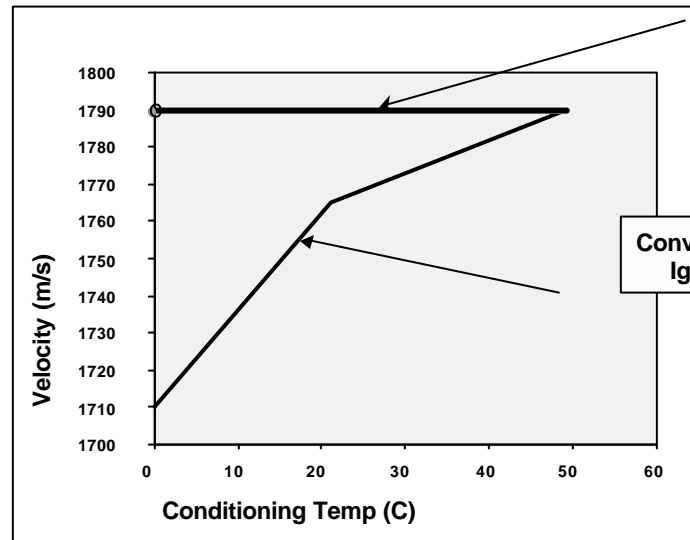
ETC is a hybrid propulsion concept using both electrical and chemical energy to provide enhanced performance



ETC Benefits



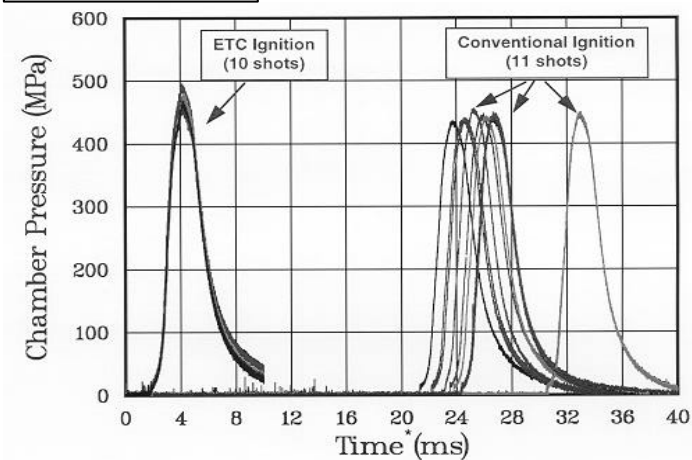
ETC Temperature Compensation



ETC Plasma Ignition



ETC Precision Ignition



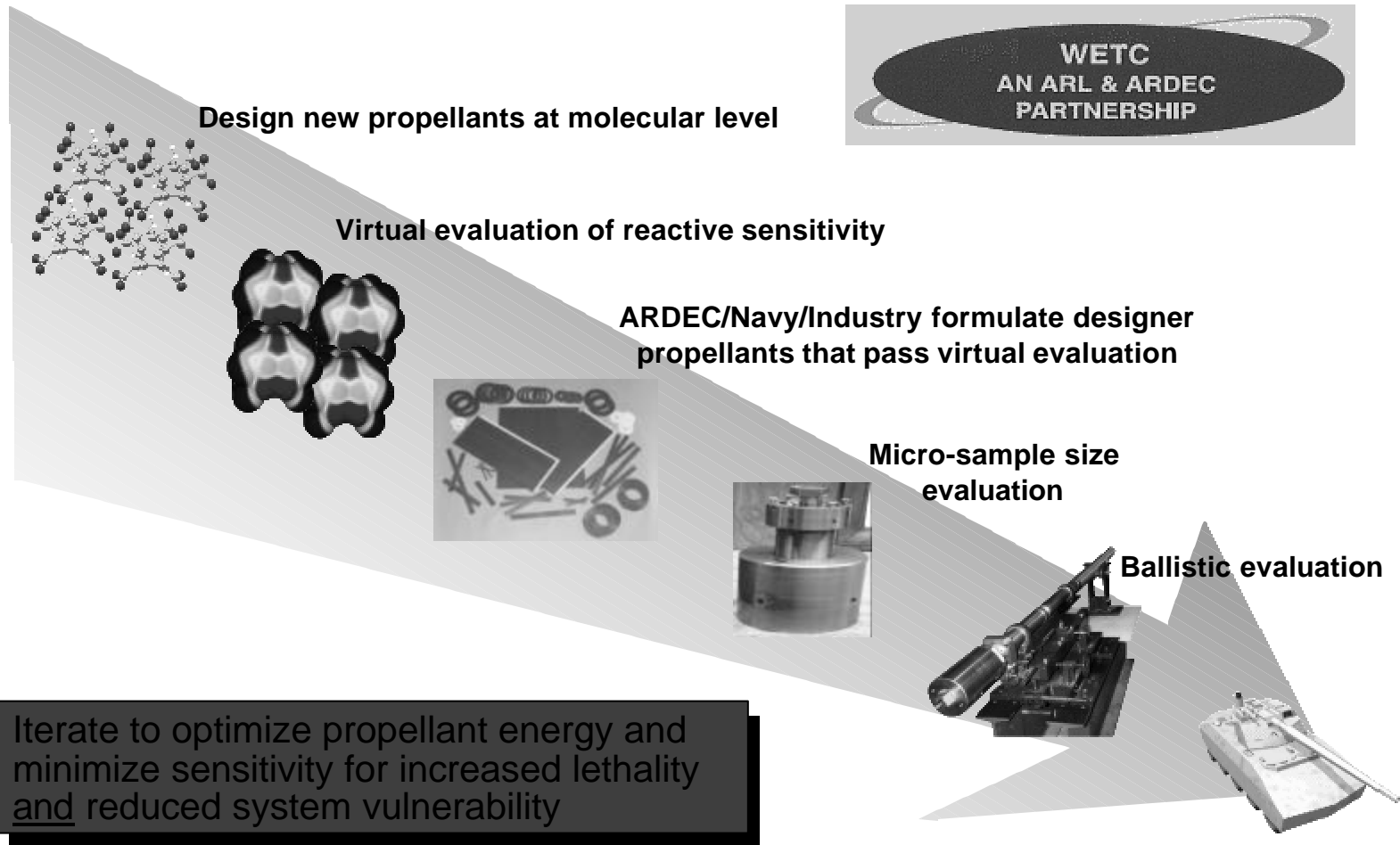
ETC

- Precisely Ignites High Energy Propellants
- Temperature Compensation
- Compatible with Projectiles

PI: Dr. William Oberle

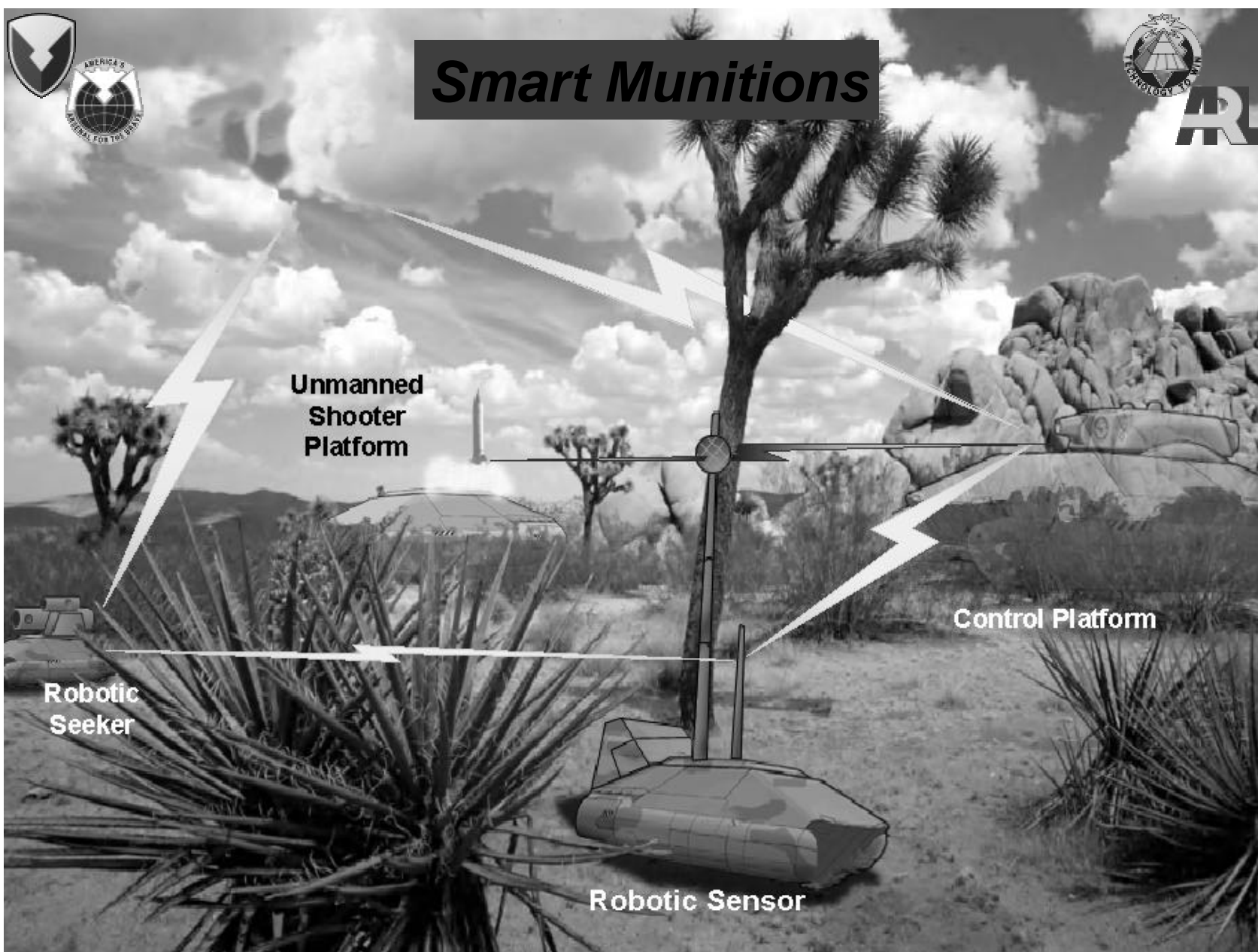


Technical approach to ETC



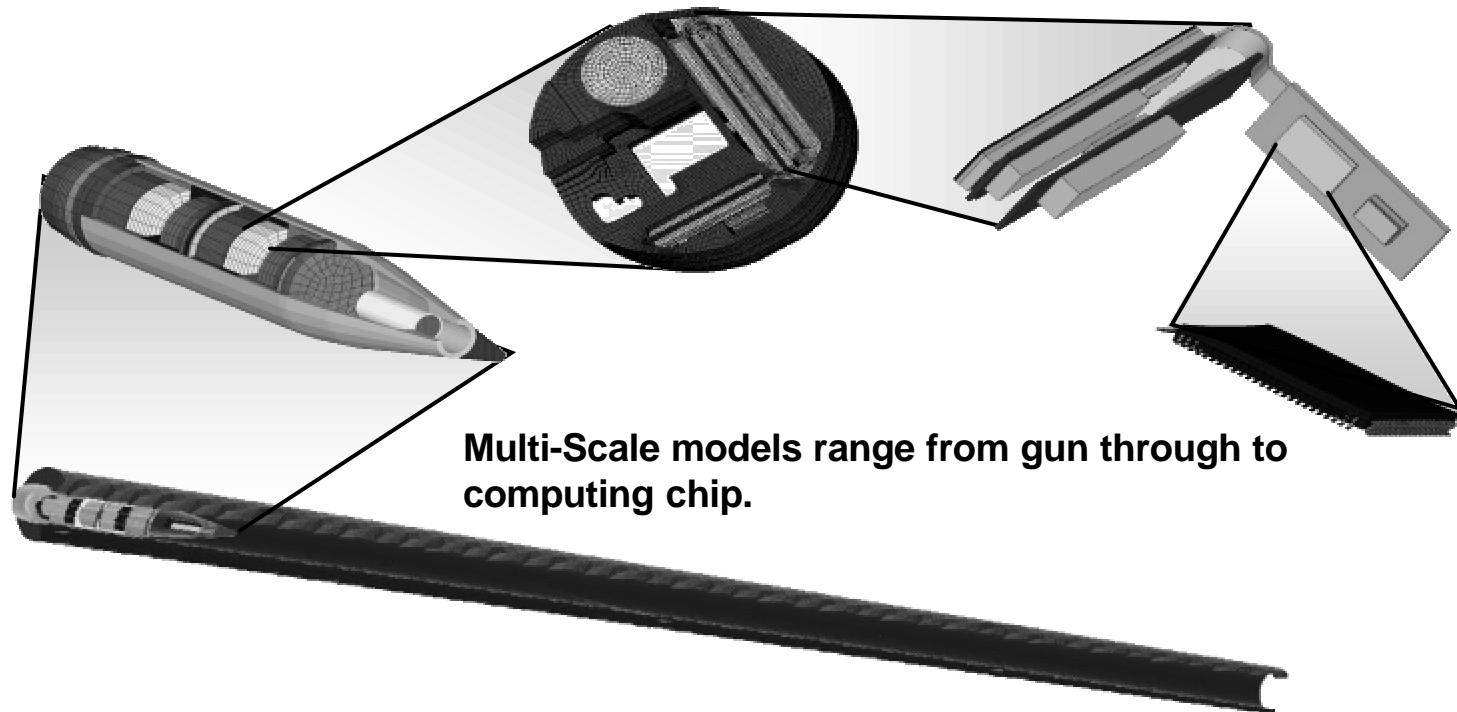


Smart Munitions





Physics of Failure: In-Bore Integrity



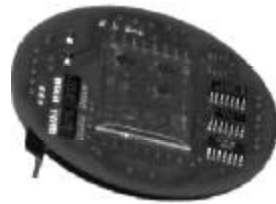
PI: Dr. Steve Wilkerson



Surface Mount
Technology



Multi-chip Module
Technology



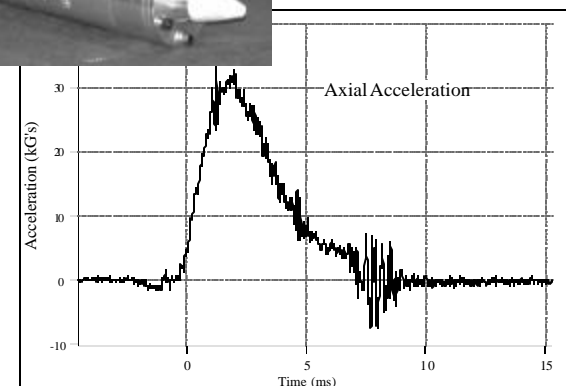
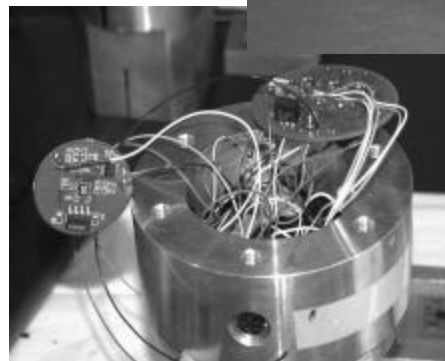
Advanced packaging reduces
Chip surface area by 25/1

G-Hardened Electronics



Validate computations with
gun launches

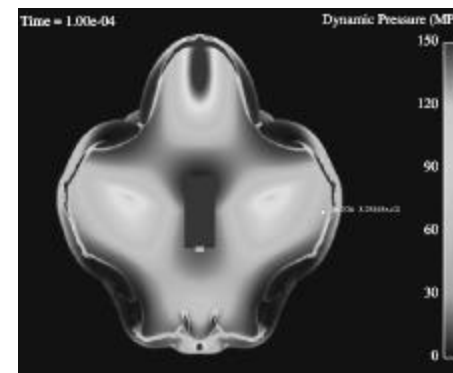
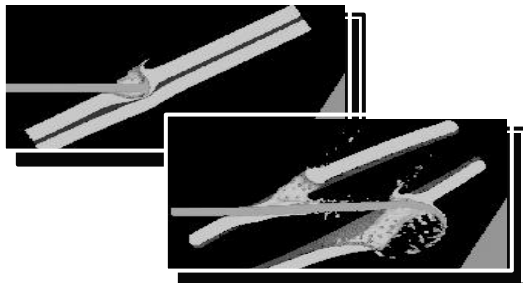
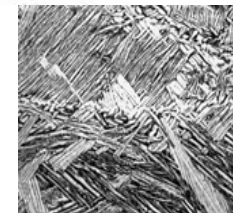
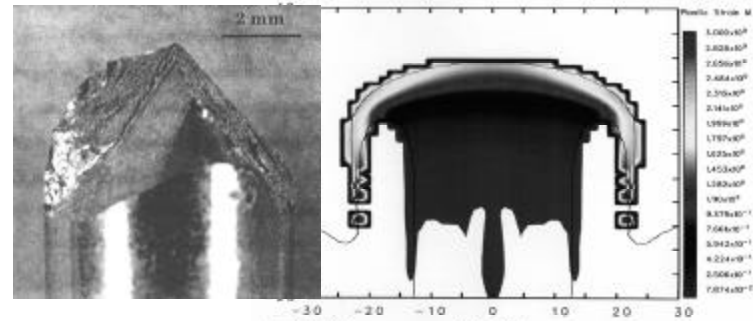
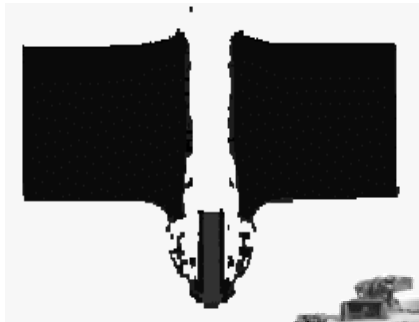
Built into tank projectile
and survives 30,000 g's



PI: Mr. Dave Hepner



Warheads and Projectiles



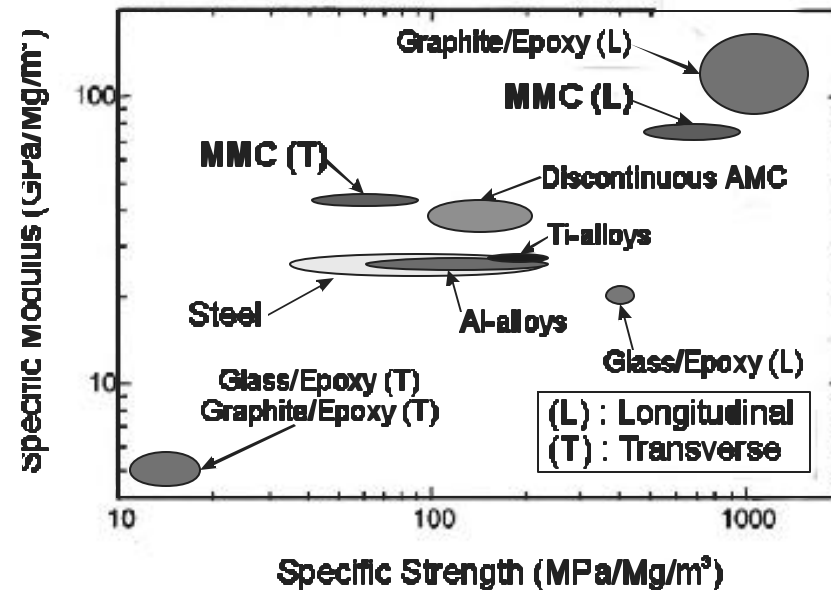
PI: Mr. Randy Coates



Metal Matrix Composites



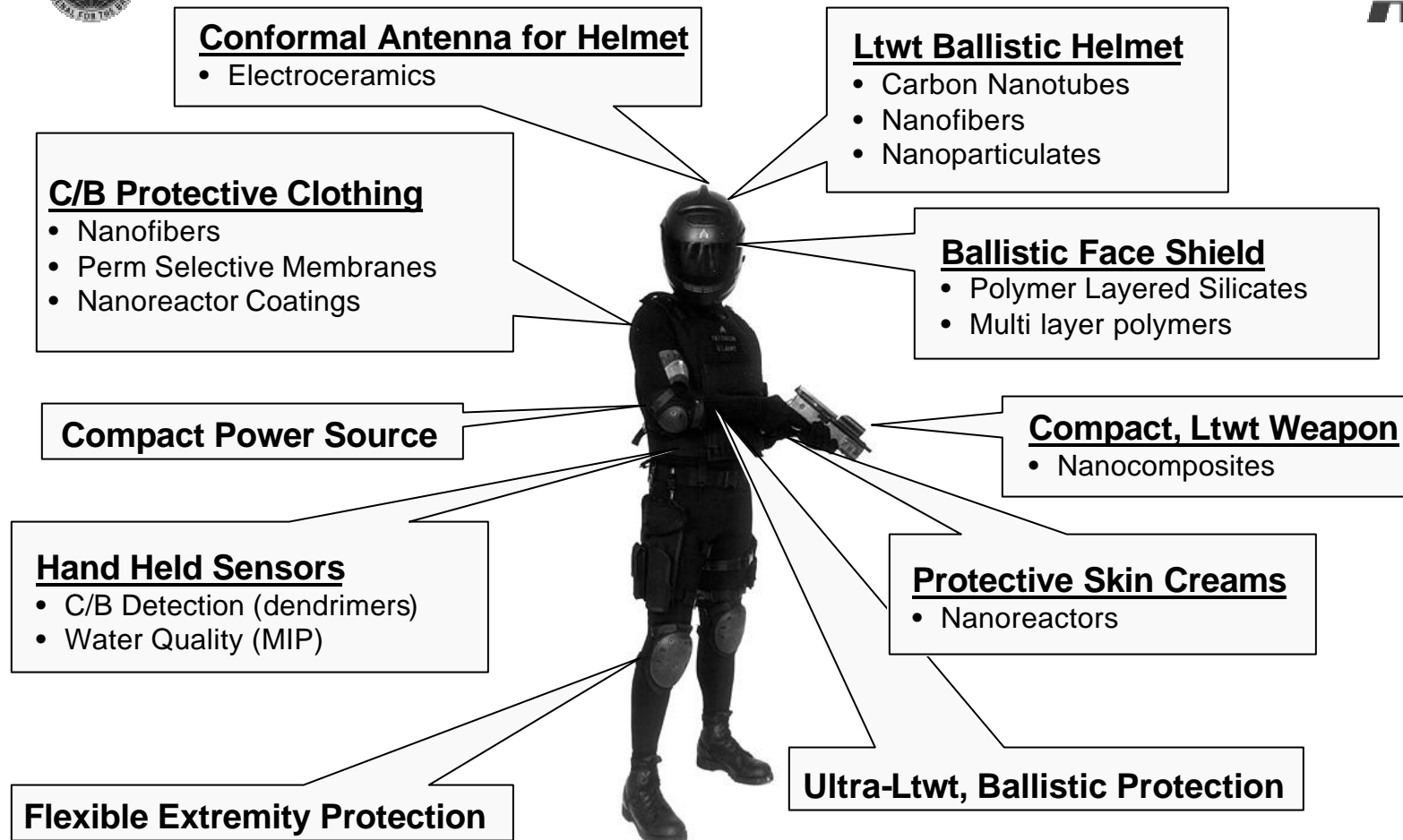
3M/DARPA program provides low-cost, reliable fiber production



Projectile shell 50% lighter than steel with parasitic volume 67% less than graphite composite



Soldier Technologies



Ultra-lightweight, Multi-functional Materials



Personnel Protection



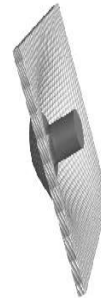
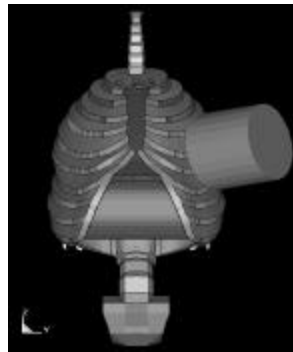
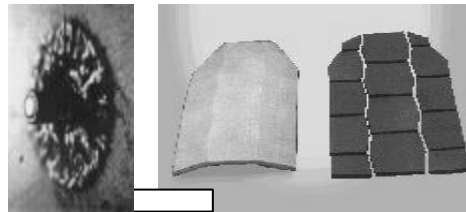
Improve body armor systems against conventional and emerging ballistic threats.

- **Lightweight and Conformal**
- **Multiple Hit Ballistic Protection**
- **Reduce Blunt Force Trauma (Fight Through)**
- **Affordable for Universal Fielding**



PI: Mr. Tom Haduch

Body Armor



Transparent Face Shield





Ultra-lightweight Flexible Materials for Extremities Protection



Battlefield Threats

•Ballistic

- Fragments
- Shrapnel
- Flechettes
- Small Arms Fire

•Blast

•Cut & Puncture

- Razor Wire
- Knives & Bayonets
- Glass

•Environment

- Flame
- Extreme Heat/Cold
- CB



Current technology is effective but imposes physiological stress on the soldier with limited extremity protection.



Novel Silk-like Biopolymer-Ceramic Hybrid Fibers

Deflection, Penetration, Cut, Puncture Resistance

Cross-linked Micellular, Impact-triggered Drug Delivery

Medical First Response

Impact Triggered, Nanostructured Polymer Hybrids

Penetration, CB, Signature



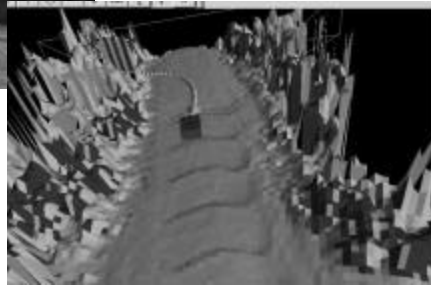
Robotics Activities: Demo III



Technology Development



- Sensors
- Perception Algorithms
- World Model
- Planning Algorithms
- Soldier-Machine Interface



Data Collection –

Developing new capabilities by getting out into the field and finding out what we don't know



Engineering Evaluations – Quantitative System Characterization



PI: Mr. Chuck Shoemaker

Troop Operation & Feedback – Exercise technology with troops on realistic terrain





Conclusion



Together we're solving problems for the future soldier.



SANDERS



3M

Thiokol Propulsion



Sarnoff
David Sarnoff Research Center
Subsidiary of SRI International

AEROJET



United Defense